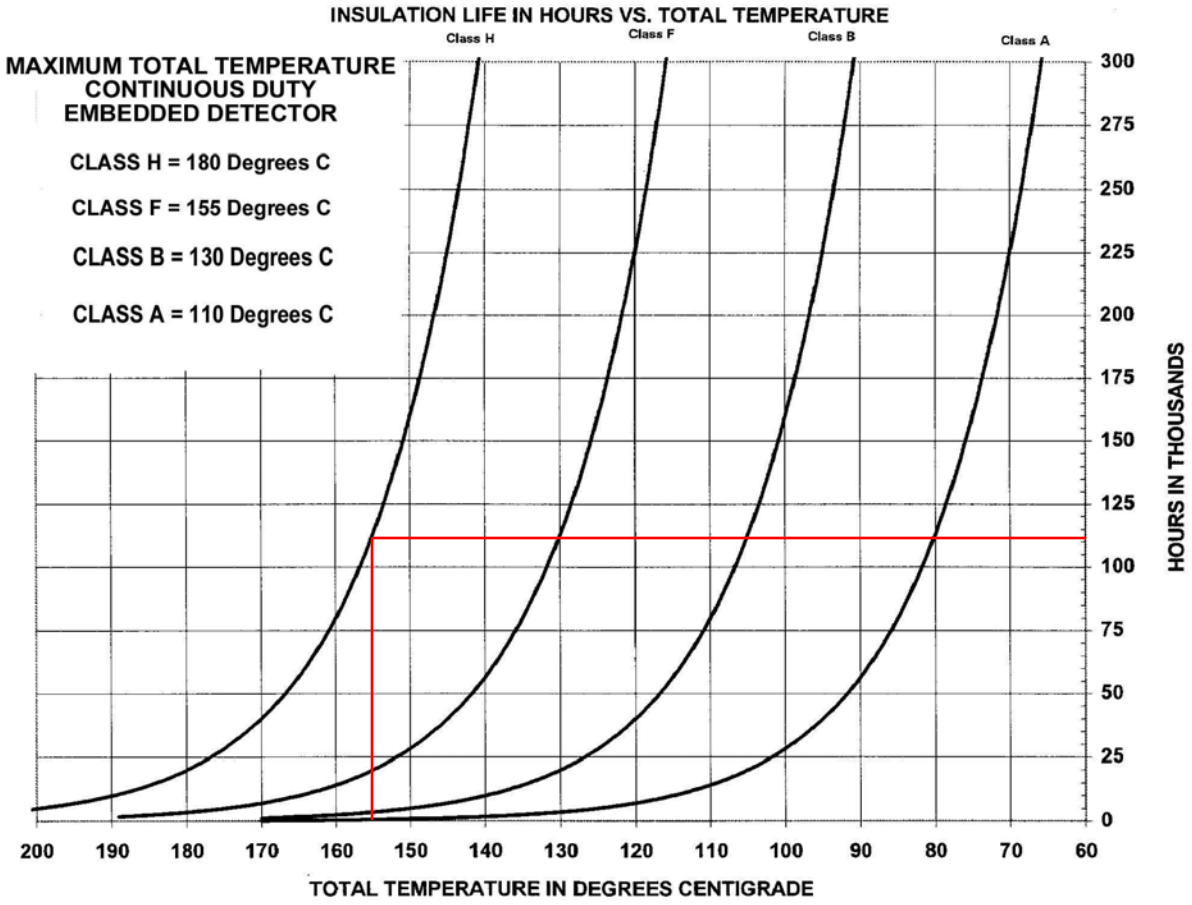
INSULATION SYSTEM THERMAL LIFE EXPECTANCY vs TOTAL OPERATING TEMPERATURE

The thermal life expectancy of an insulation system, when operated at the maximum, continuous, total temperature rating of the insulation system, is generally designed to be approximately 20,000 to 25,000 hours under ideal environmental conditions.

The “Rule of 10” (based upon the Arrhenius Equation of chemical reaction time vs temperature) can be adapted to approximate the relationship between insulation life and total operating temperature. This rule states that if a generator’s total operating temperature is reduced by 10°C, the thermal life of the insulation system is approximately doubled. Conversely, if the total operating temperature is raised by 10°C, the thermal life expectancy of the insulation system is reduced by one half.

The graph below is a tool for estimating thermal life expectancy, under ideal environmental conditions, and indicates that operating a generator at the continuous total temperature of the next lower class of insulation will increase the insulation’s thermal life by a factor of four to five. Example: A generator built with Class H insulation operated continuously at a Class F rating of 155°C will have a thermal life expectancy extended from 20 to 25 thousand hours to over 100 thousand hours.

For this reason, engineers and architects specifying an on-site electrical power generation system intended to be the primary source of electrical power for a facility may require the alternator to be rated at a temperature rise not to exceed that of one class lower than the specified class of insulation.



Continuous Duty Temperature Rises NEMA MG 1-2003 Part 33, Table 33-3

Item	Machine Part	Method of Temperature Measurement	Class B		Class F		Class H	
			Temp Rise °C	Maximum Observed Temp °C	Temp Rise °C	Maximum Observed Temp °C	Temp Rise °C	Maximum Observed Temp °C
a.	**Armature Windings** 1. All kVA Ratings	Resistance	80	120	105	145	125	165
	2. 1563 kVA and Less	Embedded Detector	90	130	115	115	140	180
	3. Over 1563 kVA							
	a) 7000 volts and less	Embedded Detector	85	125	110	150	135	175
	b) Over 7000 volts	Embedded Detector	80	120	105	145	125	165
b.	**Field Windings**	Resistance	80	120	105	145	125	165

Standby Duty Temperature Rises NEMA MG 1-2003 Part 33, Table 33-3 and Article 33.3.2.3

Item	Machine Part	Method of Temperature Measurement	Class B		Class F		Class H	
			Temp Rise °C	Maximum Observed Temp °C	Temp Rise °C	Maximum Observed Temp °C	Temp Rise °C	Maximum Observed Temp °C
a.	**Armature Windings** 1. All kVA Ratings	Resistance	105	145	130	170	150	190
	2. 1563 kVA and Less	Embedded Detector	115	155	140	180	165	205
	3. Over 1563 kVA							
	a) 7000 volts and less	Embedded Detector	110	150	135	175	160	200
	b) Over 7000 volts	Embedded Detector	105	145	130	170	150	190
b.	**Field Windings**	Resistance	105	145	130	170	150	190

Notes:

1. Class A Insulation temperature limits found in NEMA MG 1-2003 have been omitted from the above tables due to lack of current usage.

2. Maximum Observed Temperature °C is the maximum allowable temperature of the winding being observed. This value is derived by adding 40 °C ambient to the maximum allowable temperature rise for the Class of Insulation and the Method of Measurement. Should this value be exceeded, the load on the generator should be reduced until the observed temperature is reduced to a level equal to, or less than the maximum allowable limits for the Class of Insulation and duty cycle.

3. NEMA allows an increase of up to 25 °C in temperature for Stand By duty per Note 1 of Table 22-5 and article 22.85.